

CASE REPORT

Radiation therapy of a patient with implantable cardioverter defibrillator

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ABSTRACT: A number of patients who require radiation therapy may suffer from different comorbidities. Cardiac rhythm disturbances represent a comorbidity which in terms may require the implantation of a permanent pacemaker or an implantable cardioverter defibrillator. The function of these electronic implantable devices can be affected by ionizing radiation. For this reason extra caution is needed when such patients undergo radiation therapy. In this article we present the therapeutic management of a patient with an implantable cardioverter defibrillator who underwent palliative radiation therapy for lung cancer.

Key words: Radiation therapy, implantable cardioverter defibrillator, lung cancer.

INTRODUCTION

Radiation therapy (RT) is a well-established therapeutic modality in oncology and can serve as first line as well as palliative therapy for many cancer types such as lung cancer. Worldwide, lung cancer is one of the most common cancer types and counts for about 18% of all cancer related deaths.¹

Additionally, cancer patients may suffer from other ailments, such as cardiac rhythm disturbances. The severity of cardiac rhythm abnormalities may constitute an indication for the implantation of either a permanent pacemaker (PPM) or an implantable cardioverter defibrillator (ICD).² ICDs are devices that function as pacemakers and have the ability of producing a high voltage shock to the heart in order to potentially terminate lethal cardiac arrhythmias. The ionizing radiation of RT can interfere with the circuits of ICDs resulting in potentially life-threatening malfunction.³

Guidelines for the management of patients with ICD regarding RT are occasionally inconsistent and/or in-explicit.⁴

In this case we present the therapeutic management of a patient who underwent palliative radiation therapy for lung cancer and carries an ICD, according to the published recommendations for the irradiation of ICDs.

CASE PRESENTATION

A 75 year-old man was referred to our hospital with reported daily presence of bloody sputum for the last 3 months. His medical history revealed COPD, severe heart failure and atrial fibrillation, and because he fulfilled the indications he carried an ICD. The patient underwent a chest X-ray (figure 1) and a chest CT where a mass lesion was found in the right pulmonary hilum with intense homogeneous enhancement after

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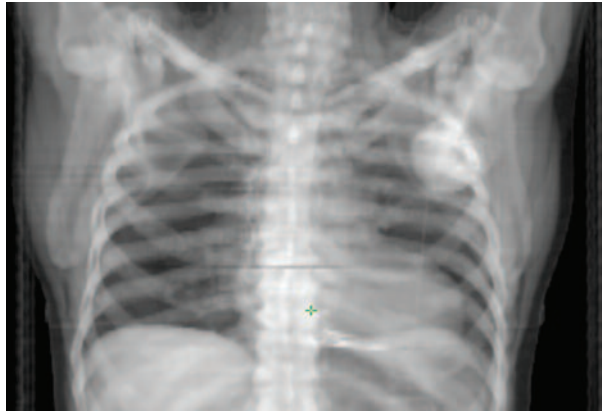


Figure 1. Chest X-Ray showing the implantable cardioverter defibrillator.

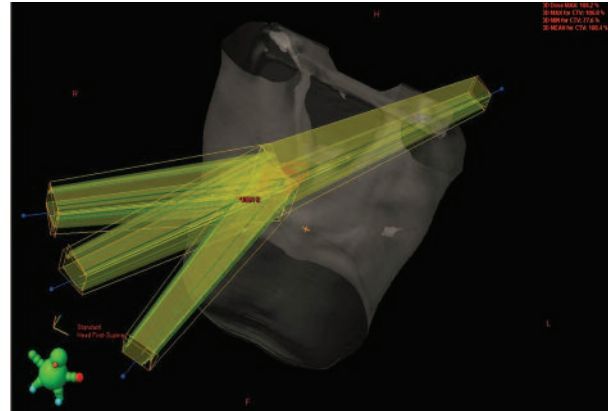


Figure 2. Multiple fields' technique to access the PTV, without insetting the ICD directly to the therapy beams.

intravenous administration of a contrast agent. The lesion was observed under the keel and posterior of the trachea along with a nodal block. Due to the known heart failure it was decided not to perform bronchoscopy for biopsy and the exclusion of chemotherapy as a therapeutic option. For these reasons the patient was referred to the department of radiation oncology for palliative-haemostatic RT.

The main problem that arose in this particular patient was that he carried an ICD. This had to be taken into consideration during the planning of any RT sessions concerning the path the external beams would take and the total radiation volume. Therefore, we contacted the manufacturing company of the ICD and after a literature review of similar cases, we managed to perform RT without any adverse effects.

According to the safety precautions of in vivo and in vitro studies about the irradiation of the ICDs, we reached the following:

1. PPMs and ICDs should not be placed in the direct therapy beam. The radiation dose can be reduced to such devices by maximizing the distance from the device to the radiation fields. This can be done by adjusting field shapes and directions, or by physically moving the device within the patient if necessary. Ideally, the device should be kept 3 cm from the edge of the unblocked machine collimator.⁵
2. After confirming that the device is located at a safe distance from the source of radiation, shielding can also be considered as an additional protection.
3. If the total dose exceeds 2 Gy, the devices should be checked prior to therapy and possibly at start of each radiation session.³

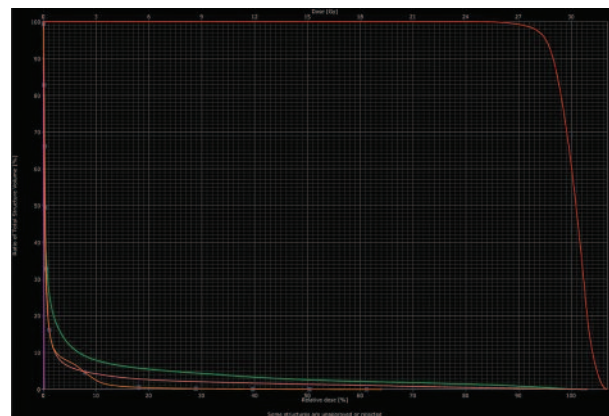


Figure 3. Dose- Volume Histogram (DVH): planning target volume- red, heart- pink, left lung- orange, ICD- purple, ICD and electrode wires-green.

4. High-energy (> 10 MV) photon beams should be avoided.

We took into consideration all the safety precautions and the fact that it was a palliative therapy and the patient underwent 10 sessions of RT with a daily dose of 3 Gy and a total dose of 30 Gy. We used multiple fields (figure 2) to access the planning tumor volume (PTV), without exceeding the daily and total acceptable dose of the ICD. The observation of the Dose- Volume Histogram (DVH) (figure 3) shows that all the critical structures receive safe dose according to international guidelines. Every day before the beginning of the RT session, a technician specialized in this field deactivated the ICD, and after the end of the session he turned it back on again.

The RT sessions were uneventful. The hemoptysis stopped and the patient was visibly in a better condi-

tion. Recent follow-up of the patient at 6 months post external beam radiation therapy revealed a normally functioning device with no indications for concern along with a small reduction of the mass. Further therapy is not possible to be administered.

DISCUSSION

The increasing human life span and the development of technology over the last decades came along with an increase in the number of PPM and ICD implantations worldwide. Considering the risk factors, that are similar between heart disease and cancer, several patients suffering from both conditions present for RT treatment each year.

No uniform guidelines exist until now regarding safe maximum cumulative radiation dose for ICDs. In 1994, the American Association of Physicists in Medicine produced guidelines for the management of these patients, which have since been adopted by many radiation- oncology departments internationally.⁶ Since then, there have been significant advances in

PPM and ICD technology and clinical practice should change accordingly.⁷ The differences between models and manufacturers also contribute to the difficulty of producing universal guidelines and treating all the patients the same.

All previous studies in the field of RT and ICDs showed that radiation induced device malfunction is rare, and death associated with that malfunction even more uncommon.⁸ Apart from the immediate malfunction of the device, there is also the possibility of delayed effects, although, no such evidence exist thus far.⁷

The management of patients with ICDs receiving RT varies. The approach of every patient should be individualized and a great deal of thought and planning should be given before the beginning of RT. A better understanding of the effects, both immediate and late, of RT on these devices will simplify management and avoid unnecessary procedures. Therefore more in-depth studies need to be conducted on the effect of radiation on PPMs and ICDs.

Εξωτερική ακτινοθεραπεία θώρακος σε ασθενή με καρδιακό απινιδωτή.

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ΠΕΡΙΛΗΨΗ: Ένας μεγάλος αριθμός των ασθενών που πάσχουν από καρκίνο και χρήζουν αντιμετώπισης με ακτινοθεραπεία υποφέρουν από διάφορα συνοδά νοσήματα. Μία πολύ συχνή περίπτωση είναι η συνοσηρότητα με καρδιακή αρρυθμία, η οποία σε πολλές περιπτώσεις απαιτεί την χρήση εμφυτεύσιμου καρδιακού απινιδωτή ή μόνιμου βηματοδότη. Η λειτουργία των ηλεκτρονικών εμφυτεύσιμων συσκευών μπορεί να επηρεαστεί από τις ιοντίζουσες ακτινοβολίες που χρησιμοποιούνται κατά την ακτινοθεραπεία. Για το λόγο αυτό, ειδικές παράμετροι πρέπει να λαμβάνονται υπ όψιν ώστε να χορηγηθεί η ακτινοθεραπεία με ασφάλεια για τον ασθενή. Σε αυτό το άρθρο παρουσιάζουμε τη θεραπευτική αντιμετώπιση ενός ασθενούς πάσχων από καρκίνο πνεύμονα ο οποίος έχριζε παρηγορητικής θεραπείας με ακτινοθεραπεία και ταυτόχρονα έφερε και εμφυτεύσιμο καρδιακό απινιδωτή.

Λέξεις κλειδιά: ακτινοθεραπεία, καρδιακός απινιδωτής, καρκίνος πνεύμονα.

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